

REMARKS

Examiner's comments in the Office Action dated May 13, 2008 have been carefully considered by Applicants. Applicants believe that the pending claims are both novel and non-obvious in view of all known prior art, that the claims properly comply with all applicable statutory requirements, and that the pending claims are in a condition for allowance.

Amendments to the Specification

Applicants have amended the specification to provide application serial number information for the two related, and still pending, applications that were filed simultaneously with the present application. Applicants respectfully maintain that no new matter has been added to the present application.

Rejection of claims 1-20 Under 35 U.S.C. § 103(a)

In the Office Action, the Examiner rejected claims 1-20 under 35 U.S.C. §103(a) as being rendered obvious, and therefore unpatentable over Sharp et al., "Optimal Preview Car Steering Control," published in Vehicle System Dynamics, Volume 35, no. ICTAM, in 2001, in view of Peng et al., "Optimal Preview Control for Vehicle Lateral Guidance," published in California Partners for Advanced Transit and Highways, 1991.

The present invention is directed to a simulation system comprising a controller programmed to determine a rear side slip angle of the vehicle computer model and when the rear side slip angle is greater than a predetermined threshold, the system determines a look ahead scale factor.

The rear side slip angle is determined as described in the published specification at paragraph [0033] as a function of the lateral vehicle velocity and the longitudinal vehicle velocity. Beginning at paragraph [0034] of the published specification and as claimed in independent claims 1, 10 and 19, if the rear side slip angle is greater than the threshold, a look ahead scale factor determination is made. The scale factor will be multiplied by the look ahead distance to increase the look ahead distance of the vehicle model. The look ahead scale factor increases as a function of the curvature of the road. Thus, as the curvature of the path increases,

the look ahead scale factor increases, as does the distance of the look ahead point on or near the intended path.

The simulation system of the present invention generates a current steering wheel angle that is based on the size of the error between the look ahead point and the intended vehicle path, keeping in mind that the intended vehicle path may have been increased, or decreased, by the look ahead scale factor. This allows the vehicle model to be controlled in various conditions, such as understeering, oversteering, and aggressive driving. The simulation system of the present invention increases the distance of a look ahead point on an intended vehicle path as a function of the look ahead scale factor. A new steering wheel angle is determined by comparing the intended vehicle path with the look ahead point.

The Sharp et al. reference is directed to an optimized model for three different steering control situations. As noted in the Office Action, Sharp et al. does not disclose path information comprising a road radius of curvature. Nor does the reference disclose the look ahead scale factor being a function of the intended path radius of curvature which is proportional to slip angle. Further, Applicants' respectfully assert that Sharp et al. does not disclose when a rear side slip angle is determined to be greater than a predetermined threshold, determine a look ahead scale factor and an initial look ahead point as taught and claimed in the present invention.

According to the present invention, when a rear side slip angle is determined to be greater than a predetermined threshold, a look ahead scale factor is determined and an initial look ahead point is determined. The Sharp et al. reference discloses a lateral deviation from a fixed straight line given as a discrete function corresponding to a vehicle speed. The road preview updating process is a shift register type of operation. The preview point is determined from the preview time, which is speed dependent according to the teachings of Sharp et al. The Examiner indicated in the Office Action that this is effectively "when the rear side slip angle is determined to be greater than a predetermined threshold, determine a look ahead scale factor and an initial look ahead point" as taught, and claimed, in the present invention. However, it is respectfully asserted that the time shift register type of operation relative to the vehicle's speed does not constitute disclosure or a teaching of determination of a look ahead scale factor and an initial look ahead point when a rear side slip angle exceeds a threshold value as claimed in the present invention.

Sharp et al. teaches setting a preview time based on the vehicle speed. At low speeds, a shorter preview time is all that is needed. The preview time and ultimately the preview point is not a function of curvature of the path, but of vehicle speed. The preview distance is unaffected as the same distance is previewed, just in a different amount of time for varying vehicle speeds. Therefore, it is respectfully asserted that the Sharp et al. reference also fails to teach or disclose this aspect of the Applicants' invention.

In the Office Action, the Examiner suggested that the Peng et al. reference discloses a method of controlling a vehicle using an optimal preview control algorithm, and that Peng teaches the path information comprising a road radius of curvature, and the look ahead scale factor being a function of the intended path radius of curvature which is proportional to the slip angle. Applicants respectfully traverse.

The Peng et al. reference teaches controlling steering wheel angle using known road curvature information that is measured from the road geometry or obtained from transportations agencies, and retrieved from an on-board database, read from discrete magnetic reference markers, or transmitted from road to vehicle by an available means and uses this information as a curvature of the road in determining an optimal preview control for a vehicle. Peng et al. also assumes a finite preview time in that at time, t , the road curvature is assumed to be known. Therefore, Peng et al. does not teach or disclose computing an "intended vehicle path" and is incapable, even in combination with Sharp et al., of simulating control of a vehicle in various driving conditions, such as understeer and oversteer.

Peng et al. discloses weighting matrices on lateral tracking error terms so that the controller responds to the changes in road curvature. However, the weighting matrix that is associated with road curvature is not a look ahead scale factor as claimed in the present invention. The weighting matrix disclosed in the Peng et al. reference is designed to minimize a disturbance, i.e., road curvature, over the problem duration, i.e. the preview time. So in fact the weighting matrix associated with road curvature is time dependent and does not address a scale factor that is associated with the distance of a look ahead point as claimed in the present invention. Applicants assert that Peng et al. fails to teach or disclose a look ahead scale factor that is a function of "the intended path radius of curvature" as claimed in the present invention.

It is also asserted that neither reference, either alone or in combination, teaches or discloses increasing the distance of a look ahead point substantially on or near an intended path as a function of the look ahead scale factor as claimed by the Applicants of the present invention. The Examiner indicated that Page 5, Figure 3 of Sharp et. Al teaches computing the road angle which corresponds to the slip angle and then to Page 10, second full paragraph as teaching setting a preview time based on the curvature of the path, which is proportional to slip angle. However this is significantly different than increasing the distance of a look ahead point as a function of the look ahead scale factor.

According to the teachings of Sharp, either alone, or in combination with Peng, a preview time is scaled, according to the vehicle speed or a known curvature in the road. The adjustments are such that the distance, or look ahead point, of the preview remains essentially the same. The same distance will be covered at a short time for a slow speed as will be covered at a longer time for a higher speed. Likewise, in Peng et al., a preview time is scaled so that it matches the duration of a disturbance, i.e. a curve feature in the road. In both references, the duration of the preview is dependent upon the vehicle speed, and affects the frequency with which a preview takes place, but the scale factor does not affect the distance of the look ahead point as claimed in the present invention. In the present invention, the scale factor is a function of the intended path radius and is associated with the distance of the look ahead point. The distance of a look ahead point is increased in response to the look ahead scale factor.

It is respectfully asserted that the Sharp et al. reference fails to teach or disclose determination of a look ahead scale factor when the rear side slip angle is greater than a threshold. It is also agreed that the Sharp et al. reference does not disclose path information comprising a road radius of curvature, nor the look ahead scale factor being a function of the intended path radius of curvature. It is respectfully asserted that the Peng reference does not teach or disclose determining a look ahead scale factor as claimed by the Applicants. Therefore, it is respectfully asserted that the combination of Sharp et al. and Peng et al. does not result in the Applicants' invention.

CONCLUSION

It is respectfully requested the Examiner withdraw the rejection of claims 1-20 under 35 U.S.C. §103(a) and that a formal Notice of Allowance be issued for all claims. Should the Examiner have any questions with respect to any matter now of record, the Examiner is invited to contact the undersigned attorney.

Respectfully submitted,

ANGELA M. BRUNETTI, PLLC

_____/Angela M. Brunetti/_____
Angela M. Brunetti, Reg. No. 41,647
11300 E. Caribbean Lane
Scottsdale, AZ 85255
(480)200-2054

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